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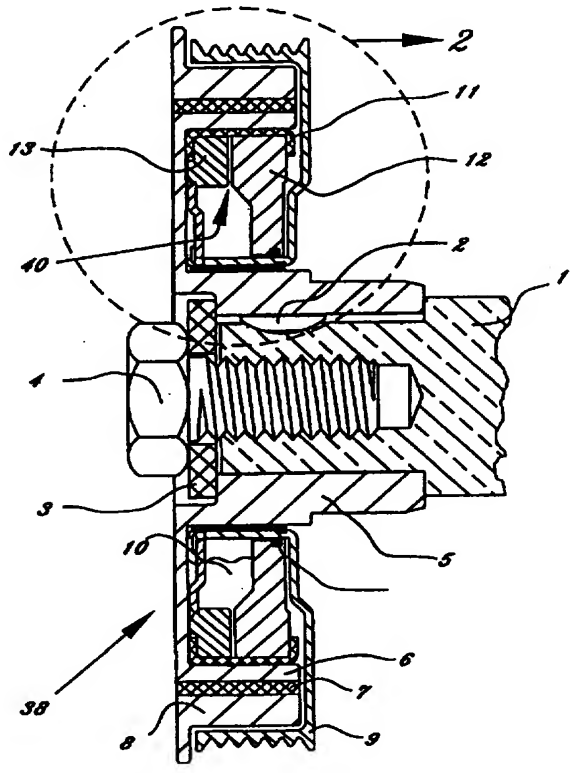
(54) Title: A CRANKSHAFT PULLEY ASSEMBLY AND ONE-WAY CLUTCH DEVICES FOR USE WITH THE ASSEMBLY

(57) Abstract

A specifically designed crankshaft pulley assembly is disclosed herein along with specifically configured one-way clutch devices for use therewith. The assembly itself is one which is adapted to be mounted to and driven by the crankshaft of an internal combustion engine, an electric motor or other such drive apparatus and which is designed for connection with an accessory drive belt for driving such accessories as, for example, an alternator. This assembly comprising (a) a crankshaft pulley including (i) a pulley body, and (ii) means connecting the pulley body to the crankshaft of the internal combustion engine, electric motor or other such drive apparatus and connecting the pulley body to the accessory drive belt for moving the drive belt in a given direction in response to the rotation of said crankshaft in a particular direction; and (b) a one-way clutch device carried by and forming part of said connecting means for allowing said drive belt to move in said given direction at a speed equal to and in excess of the speed of the crankshaft in said particular direction, whereby if the crankshaft by means of the pulley body and connecting means first causes the drivebelt to move at a specific speed and thereafter suddenly slows down, the drivebelt is not required mechanically to slow down with the drivebelt. In one embodiment, the one-way clutch device includes a unique lubricating reservoir and in a second embodiment, it includes a unique spring damper.



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A CRANKSHAFT PULLEY ASSEMBLY AND ONE-WAY CLUTCH DEVICES FOR USE WITH THE ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates to over running or one-way clutches generally and in particular to a use of a planar ratchet type of over running clutch to treat load reversal and noise in belt or chain drive rotary power systems.

Belt and chain drive systems experience noise, wear, belt slippage and excessive loads on the bearings of supporting pulley shafts when rapid deceleration of the driving pulley occurs. These effects are caused by rapidly changing and sometimes reversing loads put upon the belt by the large inertia of driven components during rapid deceleration. These reversals can cause loss of belt tension when slack in the drive belt normally taken up by a belt tensioner during normal operation is moved to the other side of the power circuit by the reversal of load due to deceleration of the drive pulley which now is driven by the inertia of some of or all the accessories on the belt.

More specifically, rapid changes in automobile engine speed during normal vehicle operation can cause an unwanted chirp or squeal to be produced by belt slippage. Modern trends such as single, long Multi-Vee belts to drive all accessories and high speed alternators with small diameter pulleys have exaggerated this problem. Figure 7 is a simplified schematic representation of such a system. The flow of power in such a system is shown in the power flow chart of Figure 8. An example of a normal operation which can cause this behavior is when a motor vehicle equipped with an automatic transmission accelerates aggressively. As the vehicle accelerates, the engine speed increases until the upper limit of engine speed is reached and the transmission shifts to a higher gear ratio. As the gear shift occurs, the engine RPM is now too fast for the existing vehicle speed and the new gear ratio. The engine is forced by the inertia of the vehicle and the newly imposed gear ratio to rapidly drop to the new engine RPM, therefore resulting in chirps and squeals. Increasing belt tension, and therefore pulley traction, can reduce belt squeal in response to this deceleration but at a cost of increased bearing loads on the system and subsequent early component failure.

Attempts have been made to put over running clutches, such as Sprag or Roller Ramp clutches, into the pulleys of some of the accessories driven by the belt. These efforts were intended to provide a means for some or all of the driven components to overrun the drive pulley when the drive pulley decelerates and when the velocity and inertia of the driven components would otherwise reverse the driving forces on the drive belt.

These efforts have had little success due to inhospitable operating conditions such as vibration, rotational speed non uniformity from the crankshaft, temperature extremes and particulate contaminants. Success has also been hindered by tough design constraints imposed by the application such as available space and lubrication requirements. Space is available in

the crankshaft pulley/damper assembly as shown in Figure 9, a power flow chart similar to Figure 8. However, putting the overrunning clutch in this location maximizes the load required to be supported as well as placing it in the most inhospitable location possible in regard to the bad operating conditions cited above. As a result, to the applicants' knowledge, prior to the present invention no one has successfully incorporated an over running clutch within such an environment.

SUMMARY OF THE INVENTION

In one aspect, the present invention is disclosed herein as a crankshaft pulley assembly which is adapted to be mounted to and driven by the crankshaft of an internal combustion engine, an electric motor or other such drive apparatus which is designed for connection with an accessory drive belt for driving such accessories as, for example, an alternator, the assembly, comprising: a crankshaft pulley including a pulley body, and means connecting the pulley body to the crankshaft of the internal combustion engine, electric motor or other such drive apparatus and connecting the pulley body to the accessory drive belt for moving the drive belt in a given direction in response to the rotation of the crankshaft in a particular direction; and a one-way clutch device carried by and forming part of the connecting means for allowing the drive belt to move in the given direction at a speed equal to and in excess of the speed of the crankshaft in the particular direction, whereby if the crankshaft by means of the pulley body and connecting means first causes the drivebelt to move at a specific speed and thereafter suddenly slows down, the drivebelt is not required mechanically to slowdown with the drivebelt.

In a further aspect the invention disclosed herein may be broadly described a one-way clutch device designed to operate at a particular intended operational orientation during normal operation, said device comprising: a main housing defining an internal chamber including a portion thereof which is the lowermost portion of the chamber when the device is operated at the operational orientation, the chamber containing lubricant therein; a plurality of mechanical components and means supporting the mechanical components during normal operation of the device in stationary positions within the chamber such that the lubricant therein rests in the lowermost portion of the chamber and for movement relative to one another in a way which causes the lubricant to move onto the components for lubricating the latter as they move. In a further aspect, the invention may be broadly described as a one-way clutch device for use in rotatably driving a given rotational output from a give rotational input, the device comprising: a drive member and means for connecting it to said input; a driven member and means for connecting it to said output, said last mentioned means including a spring damper mechanically in series with said driven member and said output when said driven member is connected to said output in the intended manner; and means for coupling said drive and driven members together so as to allow said drive member to drive said driven member with it while also allowing said driven member to move at a speed in excess of said drive member.

In yet a further aspect, the invention may be broadly described as a one-way clutch device for use in rotatably driving a given rotational output from a given rotational input, the device comprising: a drive member and means for connecting it to the input; a driven member and means for connecting it to the output, the last mentioned means including a spring damper mechanically in series with the driven member and the output when the driven member is connected to the output in the intended manner; and means for coupling the drive and driven members together so as to allow the drive member to drive the driven member with it while also allowing the driven member to move at a speed in excess of the drive member.

In view of the above, an object of the present invention is to provide a one way clutch for belt drive systems suitable for the practical operating conditions noted above which can be implemented within the design restrictions imposed by the application.

A more specific object of the invention is to produce in the system a Planar Ratchet type of one way clutch such as the one described in Pires U.S. Patent 5,070,978 (incorporated herein by reference) which is particularly well suited to enduring the forgoing adverse conditions.

Another object of the invention is to provide a particularly configured one way clutch including the system of an oil reservoir which serves as a sump when not in operation and which is centrifugally and gravitationally isolated from the clutch seals.

Yet another object of the present invention is the provision within the system of a spring damper in the load path to further treat forces due to crank shaft speed non uniformity, vibration and sudden belt loading, further quieting the system in some applications.

These objects are achieved by the utilization of a specifically designed crankshaft pulley assembly and specifically configured one-way clutch devices for use therewith. As will be described in more detail herein after, the assembly itself is one which is adapted to be mounted to and driven by the crankshaft of an internal combustion engine, an electric motor or other such drive apparatus and which is designed for connection with an accessory drive belt for driving such accessories as, for example, an alternator. This assembly, as will be seen, comprising (a) a crankshaft pulley including (i) a pulley body, and (ii) means connecting the pulley body to the crankshaft of the internal combustion engine, electric motor or other such drive apparatus and connecting the pulley body to the accessory drive belt for moving the drive belt in a given direction in response to the rotation of the crankshaft in a particular direction; and (b) a one-way clutch device carried by and forming part of the connecting means for allowing the drive belt to move in the given direction at a speed equal to and in excess of the speed of the crankshaft in the particular direction, whereby if the crankshaft by means of the pulley body and connecting means first causes the drivebelt to move at a specific speed and thereafter suddenly slows down, the drivebelt is not required mechanically to slowdown with the drivebelt.

The one-way clutch device forming part of the assembly just recited and forming one embodiment of the present invention is designed to operate at a particular intended operational

orientation during normal operation. This specifically oriented device comprising (a) a main housing defining an internal chamber including a portion thereof which is the lowermost portion of the chamber when the device is operated at said operational orientation and the chamber contains lubricant therein and (b) a plurality of mechanical components and means supporting the mechanical components during normal operation of the device (i) in stationary positions within the chamber such that the lubricant therein rests in the lowermost portion of the chamber and (ii) for movement relative to one another in a way which causes the lubricant to move onto the components for lubricating the latter as they move.

The one-way clutch device forming part of the assembly just recited and forming a second embodiment of the present invention like the first embodiment is one which is suitable for use in rotatably driving a given rotational output from a given rotational input. This device comprising (a) a drive member and means for connecting it to said input; (b) a driven member and means for connecting it to said output, the last mentioned means including a spring damper mechanically in series with the driven member and said output when said driven member is connected to the output in the intended manner; and (c) means for the drive and driven members together so as to allow the drive member to drive the driven member with it while also allowing said driven member to move at a speed in excess of said drive member. In a preferred embodiment, the spring damper is itself comprised of a plurality of compression springs mechanically in parallel with one another.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in more detail below in conjunction with the drawings, wherein:

Figure 1 is a cross sectional view of a crank shaft assembly designed in accordance with the present invention and including a crank shaft, a harmonic damper and a one way clutch pulley including a one way clutch.

Figure 2 is an enlarged view of a portion of the assembly of Figure 1 taken generally within the circled section 2 of Figure 1.

Figure 3 is a cutaway view of the assembly showing a portion of a notch plate forming part of the assembly and taken generally along lines 3-3 in Figure 2.

Figure 4 is a cutaway view of the assembly showing a portion of a pocket plate, a spring and one strut forming part of the assembly and taken generally along lines 4-4 in Figure 2.

Figure 5 is a section view through the assembled notch plate, pocket plate strut and spring taken along lines 5,6-5,6 in both Figure 3 and 4 showing the clutch in a locked configuration.

Figure 6 is a similar section view to Figure 5 showing the clutch in an unlocked or free wheeling configuration.

Figure 7 is a schematic representation of a typical automotive accessory drive system.

Figure 8 is a power flow chart of the typical accessory drive shown in Figure 7. .

Figure 9 is a similar power flow chart to Figure 8 but modified to include the present invention.

Figure 10 is a cross sectional view, similar to Figure 1, showing the crankshaft assembly in accordance with another embodiment of the present invention.

Figure 11 is a face on view taken along line 11-11 of a notch plate/spring damper arrangement forming part of the assembly of Figure 10 and shown in the unloaded or free wheeling condition.

Figure 12 is a similar view to Figure 11 taken along line 12-12 and showing the notch plate/spring damper in the fully loaded or locked condition.

DETAILED DESCRIPTION

Turning now to the drawings, wherein like components are designated by like reference numerals, Figure 1 shows a crank shaft damper-over running pulley assembly which is designed in accordance with the present invention and which is generally indicated by the reference numeral 38. The assembly is connected to crankshaft 1 which is connected to a source of rotational power (for example an internal combustion engine or other such drive arrangement) by way of key way 2 rotationally connecting crank shaft 1 to hub 5 which is held in place by washer 3 and bolt 4. Balancer flange 6 is integral to hub 5 and provides mounting for an intermediate polymer or a cast in place polymer 7 fixedly attached to both balancer flange 6 and balancer flyweight 8. Balancer flange 6 also provides mounting for annular casing 11 which is fixed to balancer flange 6 by way of a press fit or other suitable means. Annular casing 11 encloses an over running or one-way clutch device 40 which includes pocket plate 12 and notch plate 13. The notch plate 13 is axially restrained but free to revolve about the axis of crankshaft 1 within annular casing 11. Pocket plate 12 is fixed to annular casing 11 by suitable means such as a press fit and crimping.

As seen in Figure 2, notch plate 13 is fixed to plate 15 which in turn is connected to pulley 9 by way of a splined connection and snap ring 16. Bushing 17 is fixed within pulley 9 and supports pulley 9, plate 15 and notch plate 13 as one unit, for rotation on hub 5 about the axis of crankshaft 1. Seal 19 is positioned between pocket plate 12 and pulley 9 sealing the interface between. Seal 18 is similarly placed between pulley 9 and hub 5 sealing the interface between. Going clockwise, hub 5, balancer flange 6, annular casing 11, pocket plate 12, seal 19, pulley 9 and seal 18 define an enclosed annular volume 14 which is partially filled with suitable oil 10 as seen in the lower portion of Figure 1, to a level just below seal 19 when in the orientation shown in Figure 1 and also at rest.

Attention is now directed to one-way clutch 40. Turning first to Figure 3, one can see the inner surface of notch plate 13 which normally opposes the inner surface of pocket plate 12 and which has a plurality of radial slots defined by notch driving surface 20, transition knee 22 and ramp surface 21. Figure 4 shows the inner surface of pocket plate 12 which normally

opposes the inner surface of notch plate 13 and which has a plurality of pocket features 27, radially disposed, defined by pocket driving surface 24, and pocket tabs 25. These pocket features 27 serve as nests for an equal plurality of struts 23 which fit loosely in pockets 27 where their position in the plane defined by Figure 4 is constrained loosely by pocket tabs 25 and pocket driving surface 24.

Still referring to one-way clutch 40, Figure 5 shows rotation of plate 13 in a direction represented by arrow 30 causing strut 23 to move into a confrontational position between the notch driving surface 20 and the pocket driving surface 24 of pocket plate 12 under the influence of spring 28, located under each strut 23, contained in spring pockets 29 formed in pocket plate 12. Figure 6, a view similar to Figure 5, shows rotation of plate 13 in a direction represented by arrow 31 causing the transition knee 22 area of notch plate 13 to force strut 23 to move out of a confrontational position with notch plate 13 against the influence of spring 28.

One-way clutch 40 is designed in accordance with one embodiment of the present invention which incorporates a reservoir of oil 10 for lubricating the moving components of the clutch. At the same time, due to the hostile environment within the pulley assembly, it is not expected that seals 18 and 19 will remain effective for the life of the assembly. Should either or both seals fail, the positional relationship of the various components is such that (I) with the clutch at rest the oil is gravitationally below the failed seals and therefore will not leak out and (ii) during operation of the clutch, the centrifugal force to which the oil is subjected prevents it from leaking out. Otherwise, in a preferred embodiment, clutch 40 corresponds in structure and function to the one-way drive devices described in Pires U.S. Patent 5,070,978 recited previously and incorporated herein by reference.

Skipping Figures 7, 8 and 9 for now, Figure 10 shows another embodiment of the present invention, specifically a crank shaft damper-spring cushioned over running pulley assembly which is generally indicated by the reference numeral 39 and which is similar to assembly 38 with certain exceptions to be noted. Specifically, as will be seen, this latter assembly in a preferred embodiment uses a spring damper in the form of an elongated spring, actually a plurality of springs, which function in the manner to be described. To this end, notch plate 13 is fixed to spring plate 26. Spring plate 26 has formed into it a plurality of spring tabs 32 which each independently engage one end of an equal number of elongated compression springs 33 which are located in cut out sections of pulley plate 34 and drive pulley plate 34.

As seen in Figure 11, force provided by springs 33 pushing against spring tabs 32 and pulley plate 34 cause pulley plate 34, spring plate 36 and the notch plate 13 to stay in the relative position shown in Figure 11, limited in travel by the back edge of spring tab 32 abutting the travel stop tab 35 of spring plate 26.

Figure 12 shows the same arrangement of components as in Figure 11 except that the notch plate 13 and attached spring plate 26 have rotated counter clockwise relative to the pulley plate 34 in response to a force applied to notch plate 13 in a direction indicated by arrow

37, compressing springs 33 between spring tabs 32 and pulley plate 34 which in turn causes the springs 33 to exert an equal force on the pulley plate which is held stationary by an opposing force represented by arrow 36.

Having described assemblies 38 and 39 structurally, attention is now directed to the way in which they function generally and in a typical automotive accessory drive system of the type shown in Figure 7. In normal belt driving operation, rotational power from the crank shaft 1 drives the crankshaft damper - over running pulley assembly 38 in a counter clockwise direction as seen looking at the assembly 38 from a direction opposite to the crank shaft 1 in Figure 1. Rotation in this direction causes the struts 23 as seen in Figure 5 to engage both the pocket driving surface 24 of pocket plate 12 and the notch driving surface 20 of the notch plate 13. looking at Figure 2, this engagement allows counter clockwise rotational power transfer from the crankshaft 1 through key way 2, to hub 5 and balancer flange 6, on through annular casing 11, and on to pocket plate 12. Now returning to Figure 5, counter clockwise rotational power is then transmitted from pocket plate 12, through strut 23, to notch plate 13. Shifting back to Figure 2, counter clockwise rotational power from the notch plate 13 and plate 15 is transmitted to the pulley and ultimately to the accessories powered by the drive belt to be described in conjunction with Figure 7.

Operation during rapid engine deceleration causes counter clockwise rotation of the crank shaft 1 to be slower than the counter clockwise rotation of the pulley 9 as dictated by the inertia of the accessories driving the drive belt which controls the speed of pulley 9. Looking at Figure 6 this deceleration has the effect of making the notch plate rotate in the direction indicated by arrow 31 in relation to the pocket plate 12 which is also rotating but at the slower crank shaft 1 speed. As previously stated, relative rotation of notch plate 13 in the direction of arrow 31 causes the struts to disengage from the notch plate 13 and freely rotate (no reversing force generated) at any speed dictated by the net inertia of the accessories.

Looking once again at Figure 1, attention is directed to the annular volume 14 and its oil 10 supply. During normal belt driving operation, the assembly 38 rotates at the speed of the crankshaft 1 and the oil 10 spreads out and is thrown outward by centrifugal force forming an annular layer completely covering all areas of the notch plate 13 and the portion of pocket plate 12 which contain the struts 23. The oil is centrifugally prohibited from entering the seal 19 area so that in the event of failure of seals 18 and 19 due to high temperatures or particulate contamination, an adequate supply of oil 10 will not be lost. The design of the annular volume 14 is such that During periods of non operation, the oil 10 collects at the bottom of assembly 38 in what can be described as a sump, away from the seals 18 and 19 and not likely to leak even if seal 19 failure has occurred.

Returning now to Figure 10, with particular regard to assembly 39, counter clockwise rotational power from the crank shaft 1 during normal belt driving operation is treated by the crankshaft shaft damper - over running spring cushioned pulley assembly 39 identically to the previously described embodiment except that, looking now at Figures 11 and 12, the rotational

force transferred from the notch plate 13 and spring plate 26 passes through springs 33 by way of spring tabs 32 to the pulley plate 34 connected to the pulley 9 substantially cushioning shocks transmitted to the drive belt due to clutch re engagement or rough engine idle. Operation during rapid engine deceleration is identical to the previously described embodiment since rotational motion traveling in the direction of arrow 31 seen in Figure 6 is transferred directly from the pulley plate 34 seen in Figure 11 through the travel stop tab 35 to the back edge of spring tab 32 bypassing the springs 33.

Looking again at Figure 1, note the intermediate polymer spring member or cast in place polymer 7 and the balancer flyweight 8. These are components of a typical crankshaft harmonic balancer and are not relevant to the present invention except that unused space within this assembly has been co-opted for the mounting of this inventions hardware. This invention would perform the same in another location on the crank shaft 1 entirely separate from the harmonic balancer. The present invention is not limited to operation in the counter clockwise direction as presented above. If engine requirements were such that clockwise rotation were required, a simple mirroring of the features of components 12 and 13 would allow for operation in the clockwise rotational direction.

CLAIMS

1. A crankshaft pulley assembly which is adapted to be mounted to and driven by the crankshaft of an internal combustion engine, an electric motor or other such drive apparatus and which is designed for connection with an accessory drive belt for driving such accessories as, for example, an alternator, said assembly, comprising:

(a) a crankshaft pulley including

(i) a pulley body, and

(ii) means connecting the pulley body to the crankshaft of said internal combustion engine, electric motor or other such drive apparatus and connecting the pulley body to the accessory drive belt for moving the drive belt in a given direction in response to the rotation of said crankshaft in a particular direction; and

(b) a one-way clutch device carried by and forming part of said connecting means for allowing said drive belt to move in said given direction at a speed equal to and in excess of the speed of the crankshaft in said particular direction, whereby if the crankshaft by means of the pulley body and connecting means first causes the drivebelt to move at a specific speed and thereafter suddenly slows down, the drivebelt is not required mechanically to slowdown with the drivebelt.

2. The assembly according to Claim 1 wherein said one-way clutch device includes a number of mechanical components which move relative to one another when the drive belt moves and wherein said device defines an interior chamber containing lubricant for lubricating said mechanical components when the latter move relative to one another.

3. The assembly according to Claim 1 or 2 wherein when said one-way clutch is in said intended orientation, said interior chamber defines a gravitationally lowermost area, wherein said one-way clutch device is configured such that when its mechanical components do not move relative to one another the lubricant within said chamber rests within said lowermost area, and wherein when said mechanical components move relative to one another as the drivebelt moves, they do so in a way which causes the lubricant to move onto the components by centrifugal force for lubricating the components.

4. The assembly according to Claim 3 wherein the coupling arrangement includes a greater number of pockets than struts.

5. The assembly according to any one of the preceeding claims wherein said one-way clutch device includes a first and second mechanical components which move relative to one another when the drive belt moves and wherein said device defines an interior chamber containing at least one spring damper forming part of said second mechanical component, said

first and second mechanical components include drive and driven plate members, respectively and wherein said one-way clutch device includes means for coupling said plate members together and means for connecting said spring damper mechanically in series with said driven plate member, wherein said spring damper is an elongated coil spring and wherein said last mentioned means includes a first tab member connected to said driven member and to one side of said coil spring and a second tab member connected to the other side of said coil spring and to said crankshaft pulley body, said means connecting the pulley body to the crankshaft includes a hub fixedly connected to said first plate member.

6. The assembly according to Claim 1 wherein said one-way drive device includes drive and driven members and means for coupling said members to one another, wherein said driven member is connected to said pulley body, wherein said connecting means includes a hub adapted to be mounted directly to said crankshaft, and wherein said drive member is connected with said hub.

7. The assembly according to Claim 1 wherein said one-way clutch device includes drive and driven members which move rotationally relative to one another about a center point and wherein said device defines an interior chamber containing a spring damper in the form of a plurality of mechanically parallel compression springs which together are mechanically connected in series with said driven members and circumferentially spaced about a circle concentric with said center point.

8. A one-way clutch assembly designed to operate at a particular intended operational orientation during normal operation, said device comprising:

(a) a main housing defining an internal chamber including a portion thereof which is the lowermost portion of the chamber when the device is operated at said operational orientation, said chamber containing lubricant therein;

(b) a plurality of mechanical components and means supporting the mechanical components during normal operation of the device (i) in stationary positions within the chamber such that the lubricant therein rests in the lowermost portion of the chamber and (ii) for movement relative to one another in a way which causes the lubricant to move onto the components for lubricating the latter as they move.

9. The assembly according to any one of the preceeding claims wherein said internal chamber includes an opening into its ambient surroundings and wherein said one-way clutch device includes means for sealing closed said opening.

10. The assembly of any one of the preceeding claims wherein said main housing and internal chamber including said opening are configured such that once said lubricant is provided

within said interior chamber it will not escape through said opening in the absence of said sealing means or in the event said sealing means eventually fails, so long as the device remains at a particular, intended operational orientation, whereby if said sealing means should fail during normal operation of the crankshaft pulley, the lubricant within the interior chamber of the one-way clutch will not leak out.

11. The assembly of any one of the preceeding claims wherein said one-way clutch device includes:

(a) first and second members including first and second planer surfaces, respectively;

(b) means for supporting said first and second members such that said first and second planer surfaces are adjacent to and in confronting relationship with one another and such that said members are rotatably movable relative to one another about a common axis; and

(c) a coupling arrangement including a series of circumferentially spaced first pockets defining strut engaging first shoulders in the first planer surface of said first member, a series of circumferentially spaced second pockets defining strut engaging second shoulders in the second planer surface of said second member, and at least one strut having opposing shoulder engaging edges and carried by the surface of one of said members

(I) for causing said first and second members to rotate together in one direction about said common axis, and

(ii) for allowing said second member to rotate freely in the opposite direction about said common axis and relative to said first member.

12. The assembly according to Claim 3 or 11 wherein when said members rotate together in said one direction, the opposing shoulder engaging edges of at least one strut engages the first and second shoulders of an adjacent pair of first and second pockets in a way which places a compressive load across that strut between its engaging edges, said one-way clutch device including a plurality of struts, wherein said struts and pockets are configured such that the opposing shoulder engaging edges of one and only one of said struts respectively engage the first and second shoulders of an adjacent pair of first and second pockets when said members rotate together.

13. The assembly according to Claim 12 wherein the coupling arrangement includes a greater number of first pockets than second pockets and struts.

14. The assembly according to Claim 3 or 11 wherein each of said struts is wider than it is thick and each of said opposing edges is a generally rectangular, parallel, flat surface defined by the thickness and length of the strut, said strut being longer than it is wide.

15. A one-way clutch device for use in rotatably driving a given rotational output from a given rotational input, said device comprising:

(a) a drive member and means for connecting it to said input;

(b) a driven member and means for connecting it to said output, said last mentioned means including a spring damper mechanically in series with said driven member and said output when said driven member is connected to said output in the intended manner; and

(c) means for coupling said drive and driven members together so as to allow said drive member to drive said driven member with it while also allowing said driven member to move at a speed in excess of said drive member.

16. A one-way clutch device according to Claim 15 wherein said spring damper includes a coil spring and wherein the means for connecting the driven member to the output includes a first mechanical tab connected to said driven member and to one end of said coil spring and a second mechanical tab connected to the other end of said spring and adapted for connection to said output.

17. A crankshaft pulley assembly according to Claim 1 wherein said crankshaft pulley includes a vibration damper separate from said one-way clutch device.

FIG. 1

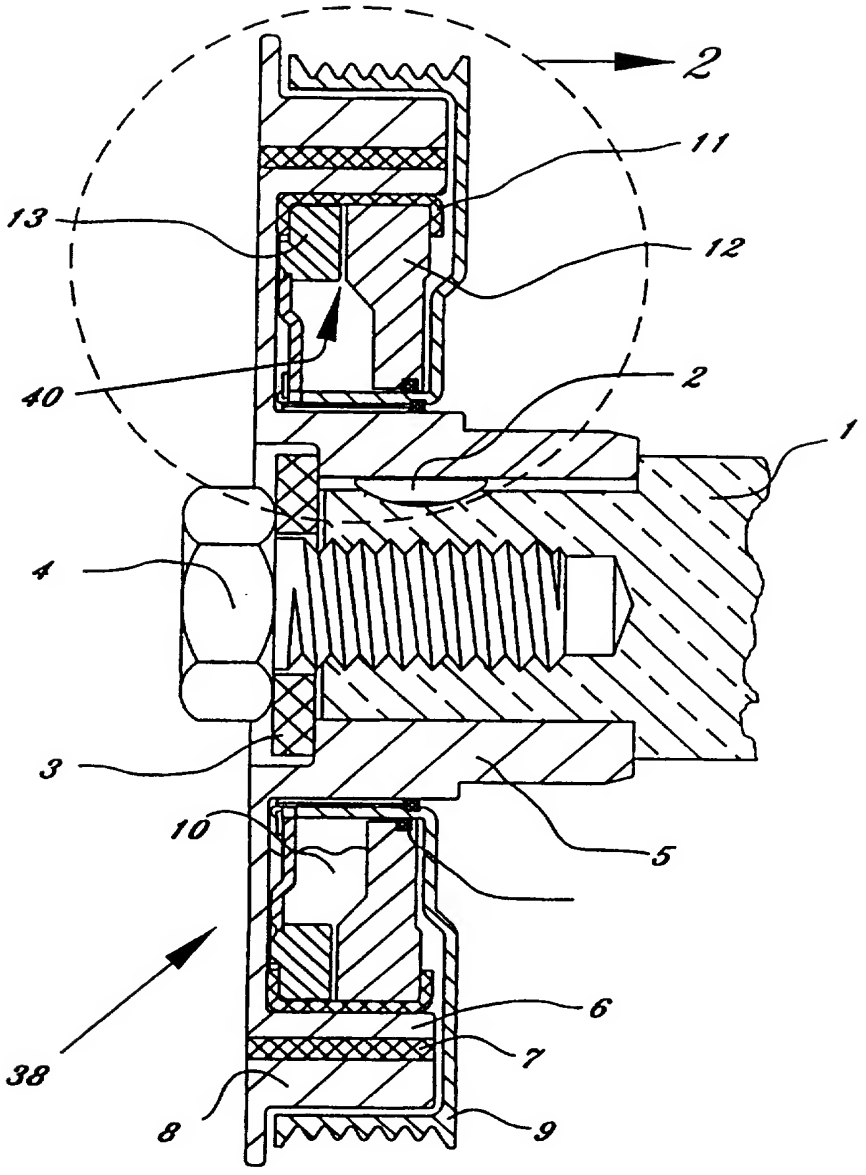


FIG. 2

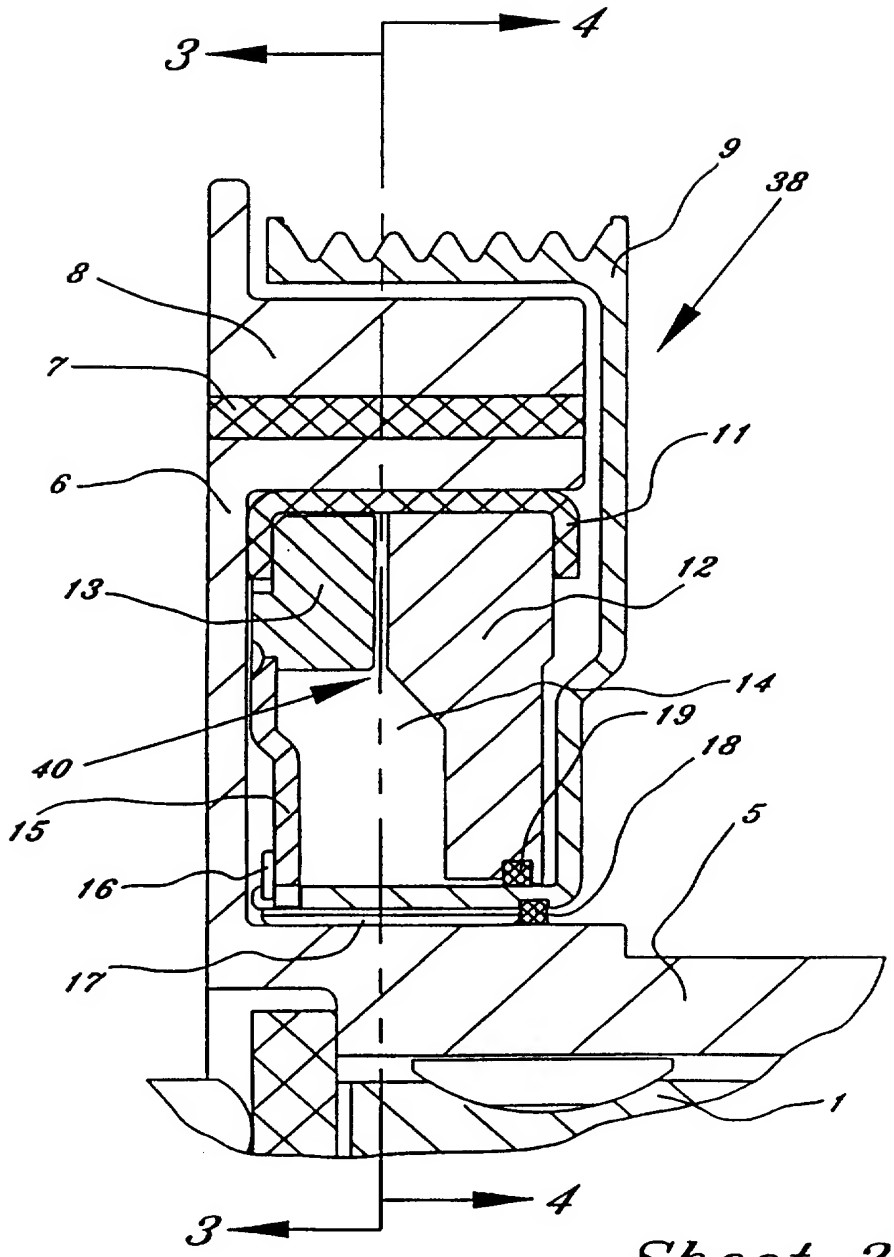


FIG. 3

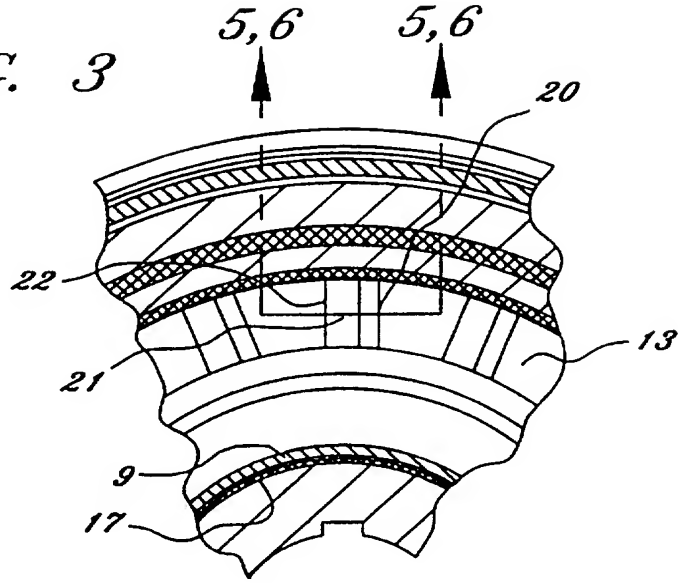


FIG. 4

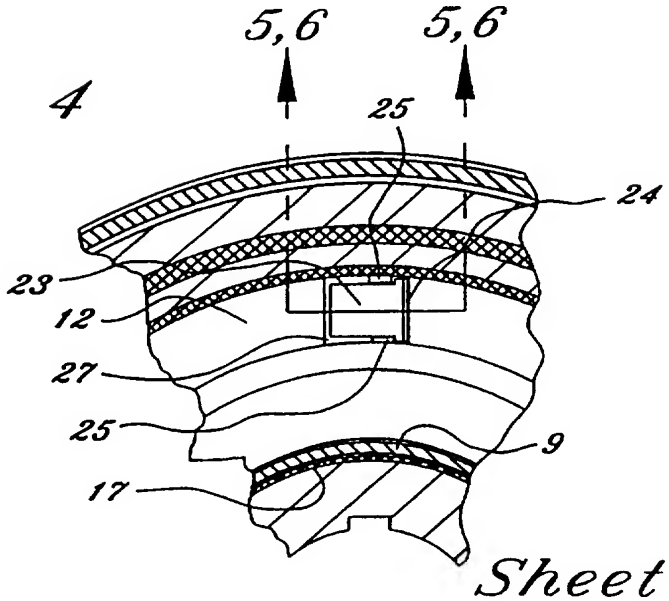


FIG. 5

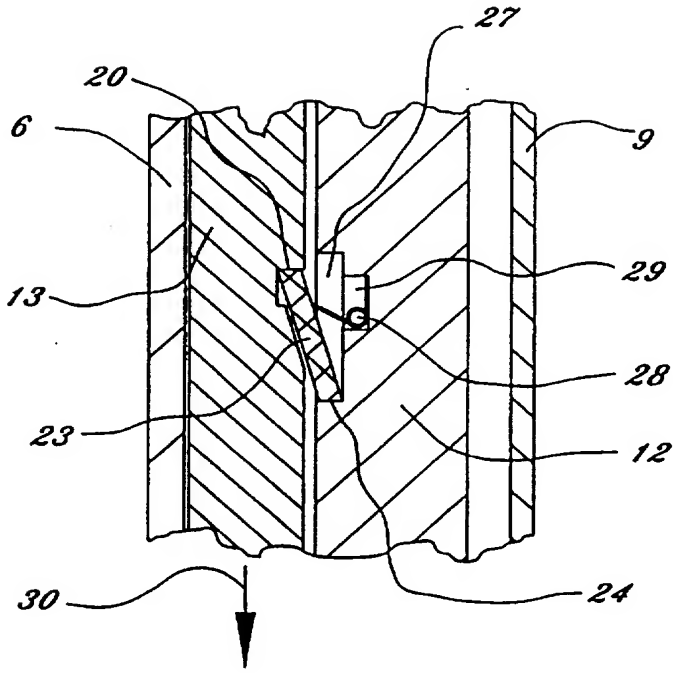


FIG. 6

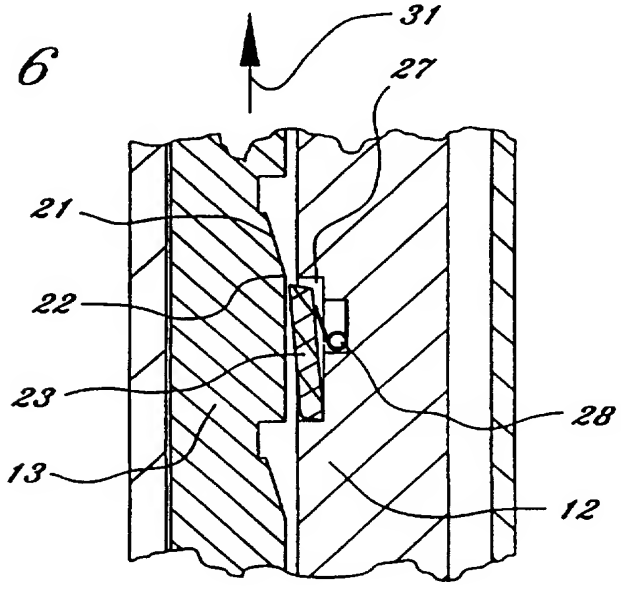


FIG. 7

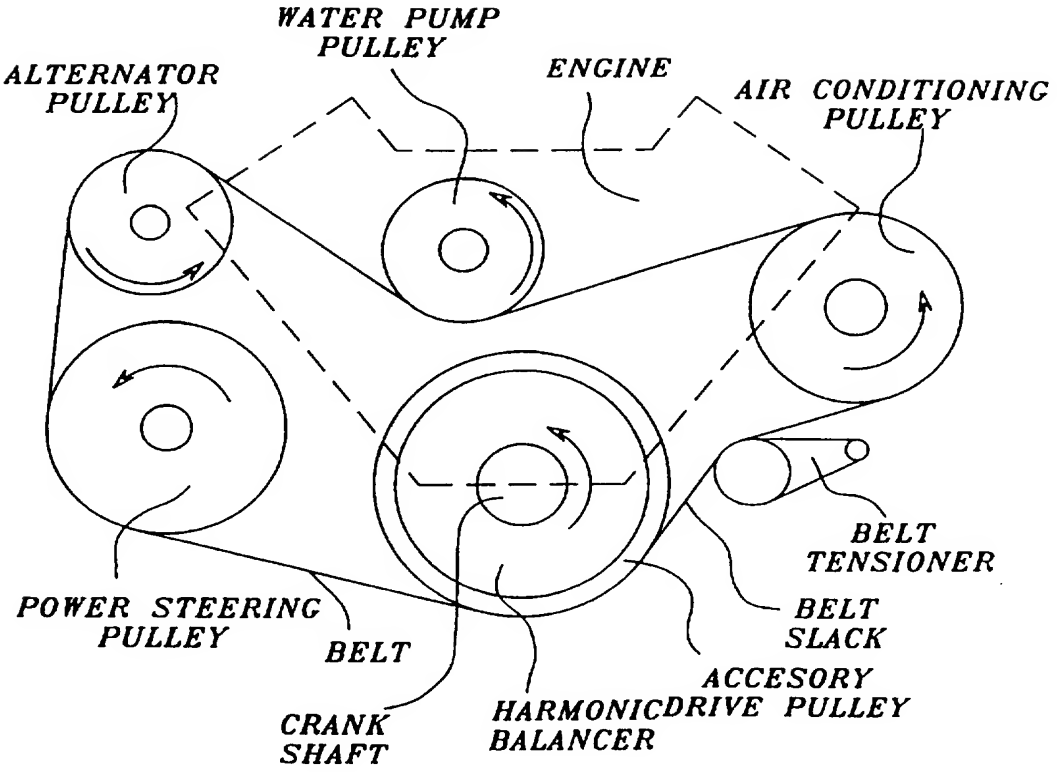

WATER PUMP PULLEY
ALTERNATOR PULLEY
ENGINE
AIR CONDITIONING PULLEY
BELT TENSIONER
POWER STEERING PULLEY
BELT
BELT SLACK
ACCESORY DRIVE PULLEY
CRANK SHAFT
HARMONIC BALANCER

FIG. 8

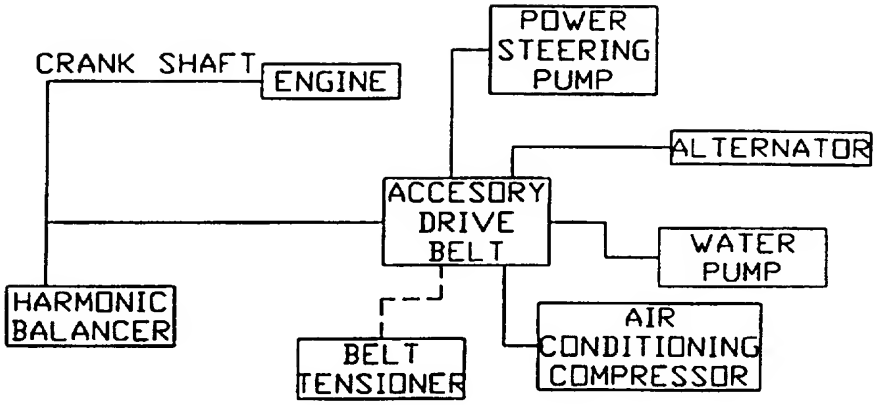

CRANK SHAFT
ENGINE
POWER STEERING PUMP
ALTERNATOR
ACCESORY DRIVE BELT
WATER PUMP
HARMONIC BALANCER
BELT TENSIONER
AIR CONDITIONING COMPRESSOR

FIG. 9

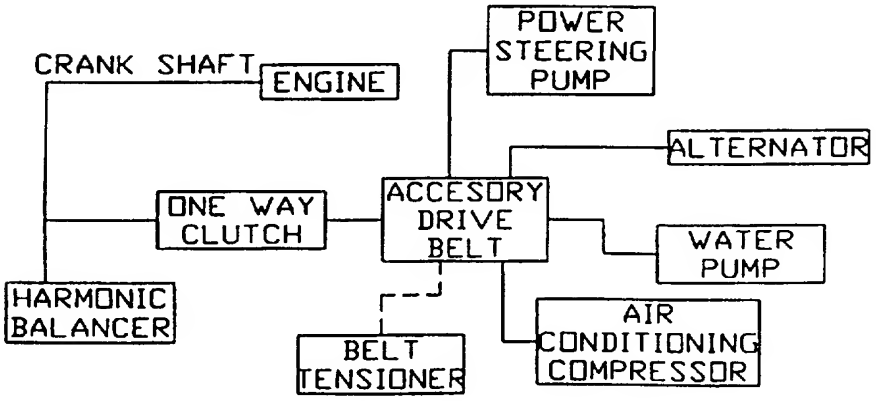

CRANK SHAFT
ENGINE
POWER STEERING PUMP
ALTERNATOR
ONE WAY CLUTCH
ACCESORY DRIVE BELT
WATER PUMP
HARMONIC BALANCER
BELT TENSIONER
AIR CONDITIONING COMPRESSOR

FIG. 10

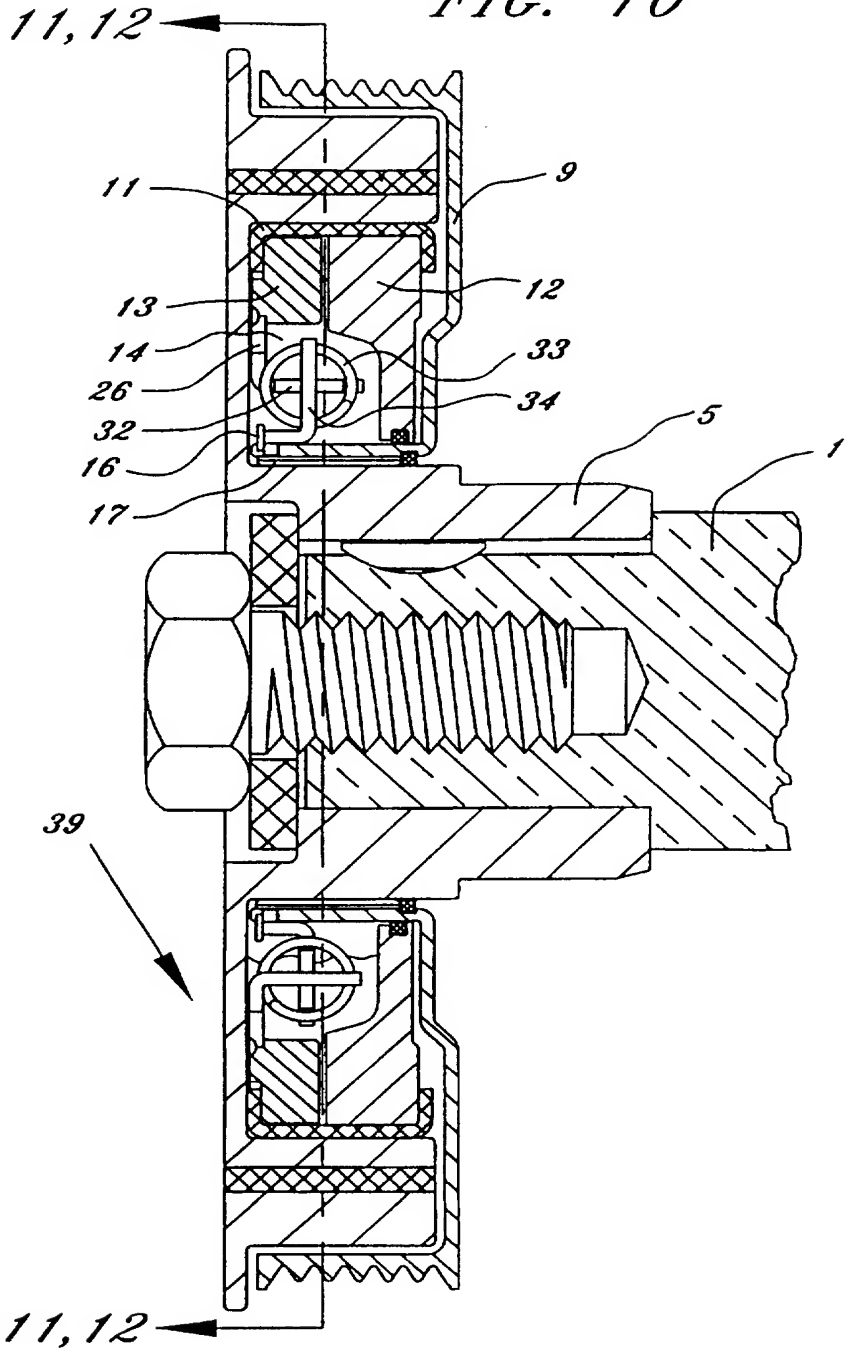
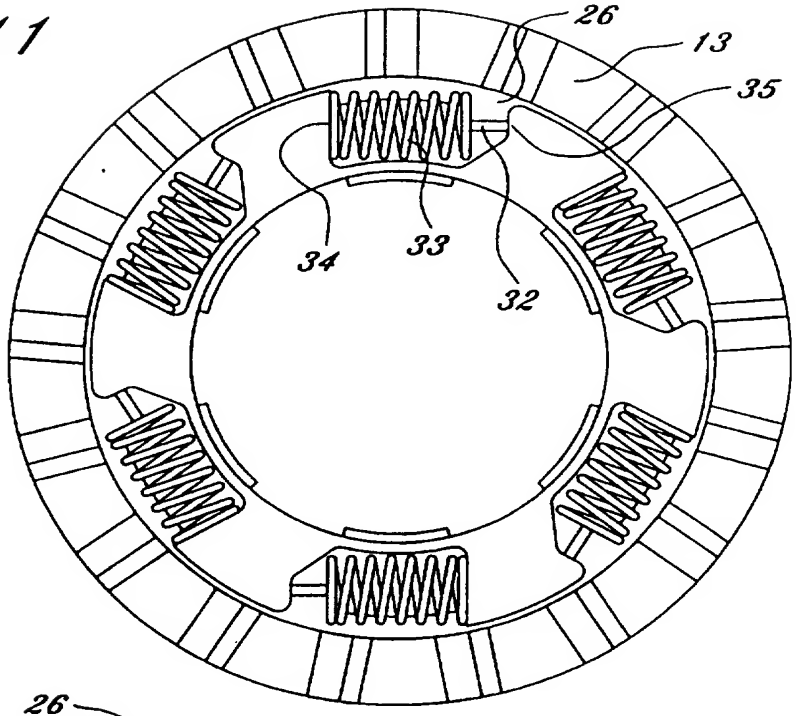


FIG. 11



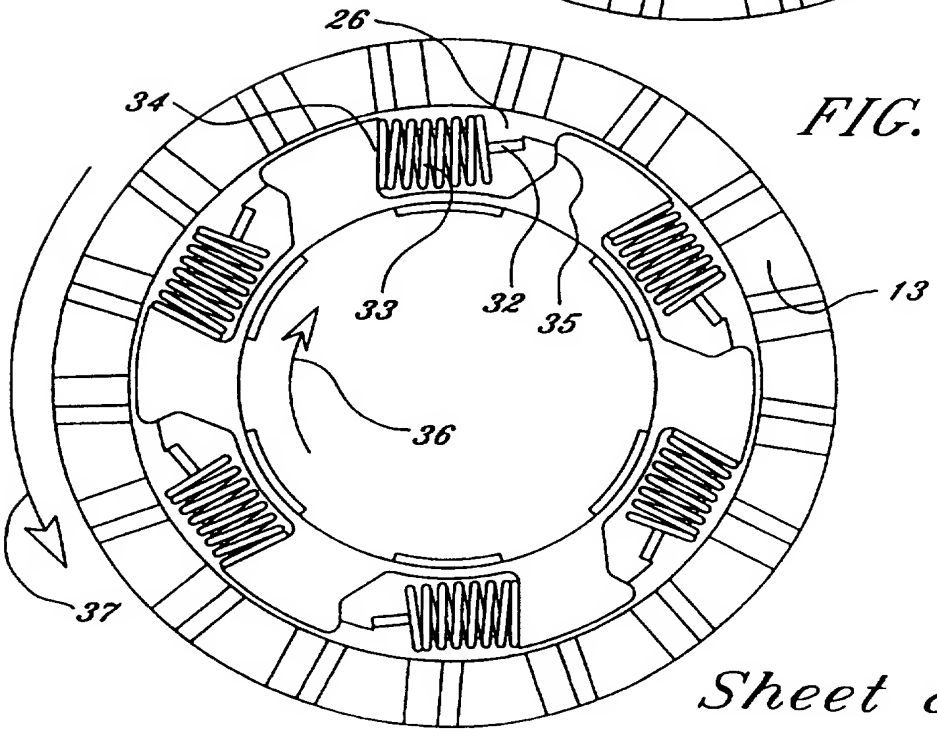


FIG. 12

INTERNATIONAL SEARCH REPORT

Int. ..tional Application No PCT/US 97/01999

A. CLASSIFICATION OF SUBJECT MATTER

F 16 H 55/36,F 16 D 41/12,F 16 F 15/123,F 02 B 67/04

According to International Patent Classification (IPC) or to both national classification and IPC 6

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F 02 B,F 16 D,F 16 F,F 16 H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,A	DE, C, 4 036 209 (MERCEDES-BENZ AKTIENGESELL-SCHAFT) 07 May 1992 (07.05.92), the whole document. --	1-3, 4-17
A	US, A, 5 070 978 (P.B. PIRES) 10 December 1991 (10.12.91), (cited in the application). --	1,11-17
A	DE, C, 4 426 690 (MERCEDES-BENZ AKTIENGESELL-SCHAFT) 29 June 1995 (29.06.95), the whole document. --	1-17
A	DE, A, 4 420 178 (LUK LAMELLEN UND KUPPLUNGS-	1-17

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search
14 May 1997

Date of mailing of the international search report
05.06.97

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WERDECKER e.h.

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	BAU GMBH) 22 December 1994 (22.12.94), the whole document. ----	

ANHANG

zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

ANNEX

to the International Search Report to the International Patent Application No.

ANNEXE

au rapport de recherche international relatif à la demande de brevet international n°

PCT/US 97/01999 SAE 153529

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The Office is in no way liable for these particulars which are given merely for the purpose of information.

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visée ci-dessus. Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l'Office.

Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
DE C1 4036209	07-05-92	keine - none - rien	
US A 5070978	10-12-91	AT E 142752 DE D0 69122096 DE T2 69122096 EP A1 [illegible] EP A4 [illegible] EP B1 [illegible] JP T2 5506707 WO A1 9116552	15-09-96 17-10-96 03-04-97 03-02-93 16-05-94 11-09-96 30-09-93 31-10-91
DE C1 4426690	29-06-95	keine - none - rien	
DE A1 4420178	22-12-94	keine - none - rien	

PUB-NO: WO009731198A1

DOCUMENT-IDENTIFIER: WO 9731198 A1

TITLE: A CRANKSHAFT PULLEY ASSEMBLY AND ONE-WAY CLUTCH DEVICES FOR USE WITH THE ASSEMBLY

PUBN-DATE: August 28, 1997

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FITZ, FRANK	N/A

ASSIGNEE-INFORMATION:

NAME	COUNTRY
EPILOGICS L P	US

APPL-NO: US09701999

APPL-DATE: February 6, 1997

PRIORITY-DATA: US60422296A (February 22, 1996)

INT-CL (IPC): F16H055/36 , F16D041/12 , F16F015/123 , F02B067/04

EUR-CL (EPC): F16H055/36 , F16D041/12 , F16D041/12 , F16F015/126 , F16F015/14

ABSTRACT:

A specifically designed crankshaft pulley assembly is disclosed herein along with specifically configured one-way clutch devices for use therewith. The assembly itself is one which is adapted to be mounted to and driven by the crankshaft of an internal combustion engine, an electric motor or other such drive apparatus and which is designed for connection with an accessory drive belt for driving such accessories as, for example, an alternator. This assembly comprising (a) a crankshaft pulley including (i) a pulley body, and (ii) means connecting the pulley body to the crankshaft of the internal combustion engine, electric motor or other such drive apparatus and connecting the pulley body to the accessory drive belt for moving the drive belt in a given direction in response to the rotation of said crankshaft in a particular direction; and (b) a one-way clutch device carried by and forming part of said connecting means for allowing said drive belt to move in said given direction at a speed equal to and in excess of the speed of the crankshaft in said particular direction, whereby if the crankshaft by means of the pulley body and connecting means first causes the drivebelt to move at a specific speed and thereafter suddenly slows down, the drivebelt is not required mechanically to slow down with the drivebelt. In one embodiment, the one-way clutch device includes a unique lubricating reservoir and in a second embodiment, it includes a unique spring damper.